ALUMINIUM-MAGNESIUM ALLOYS.

THERE have recently appeared accounts of a 'newly discovered' series of alloys of aluminium and magnesium which are considered by their discoverers peculiarly valuable and promising. Dr. Mach, for example, has named such alloys 'magnalium.' Possibly other investigators may not be aware that this series was long ago investigated at the suggestion of the writer and in considerable detail in the laboratories of Sibley College. The writer published an account of the work in 1893 and it has been reproduced or summarized in several cases since.* The following are the tabulated results of such tests of strength of the two metals and their alloys as then determined. The succeeding graphic illustration of their variation of quality and the law of such variation is from a paper read by Professor Carpenter, in 1898, before the American Society of Mechanical Engineers and published in their transactions for that year.

TENACITY OF MAGNESIUM.

Number of Test Piece.	Diameter.	Breaking Load Lbs.	Breaking Load Lbs. per sq. in.	Elastic Limit Lbs. per sq. in.	Extension per cent.	Modulus of Electricity.
1	.433	3,500	23,800	8,800	4 2	2,040.000
2	.433	3,250	22,050	.....	.....	1,860,000
3	.442	3,200	20,900	10,780	1.8	2,060,000
4	.435	2,900	19,500	8,400	2.5	1,830,000
5	.424	3,500	24,800	7,090	3.1	1,930,000
6	.432	3,300	22,500	.....	2.3	.....

ALLOYS OF ALUMINIUM AND MAGNESIUM.

Number of Test Piece.	Percentage of Magnesium.	Specific Gravity.	Breaking Strength. lbs. per sq in.	Elastic Limit. lbs. per sq. in.	Modulus of Elasticity.
1	0	2.67	13,685	4,900	1,690,000
2	2	2.62	15,440	8,700	2,650,000
3	5	2.59	17,850	13,090	2,917,000
4	10	2.55	19,680	14,600	2,650,000
5	30	2.29	5,000	.....	.....

From this table it will be seen that, for magnesium, the

Average breaking strength is	22,250 lbs. per sq. in.
Average elastic limit is.....	8,870
Average elongation is.....	2.8 per cent.
Average modulus of elasticity is.....	1,945,000

It is noticeable that though the density of the metal is only two-thirds that of aluminium it has one-half more tensile strength; the latter averaging, pure, about 15,000 pounds.

The addition of magnesium to aluminium reduced ductility steadily with rising proportions and, at one-third magnesium and two-thirds aluminium, the alloy was as brittle as glass. Magnesium refused to alloy with iron. The alloys with aluminium, where the proportion of magnesium is small, give promise of finding useful and valuable applications in the arts.

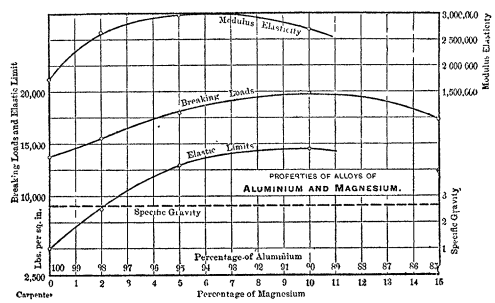
The series of tests of which the diagram

* For earlier work on properties of magnesium and its alloys, see 'Materials of Aëronautic Engineering,' *Transactions Aëronautic Congress*, Chicago, 1893; also *Sibley Journal*, April, 1894.—R. H. T.

'Magnesium as a Constructive Material.'—R. H. T. *London Machinery*, May, 1896; 'Industries and Iron,' May 22, 1896. Also Thurston's 'Materials of Engineering,' vol. iii., pp. 94-561.

'Mechanical Properties of certain Aluminium Alloys,' R. C. Carpenter; Trans. A. S. M. E., vol. xix., 1898, No. DCCLXXXIV.

is the record in graphical form were made in 1893 by Messrs. Marks and Barraclough in the course of regular graduate work in



the mechanical laboratories of Sibley College.* The writer had always anticipated useful employment of such alloys, since the properties of magnesium became familiar to him, in the experimental use of the metal for signal purposes in army and navy, 'in the sixties,' with the assistance of Admiral Luce and of General Myer, then Chief Signal Officer of the Army of the United States.

The volatility and combustibility of the lighter metal are elements of difficulty in its use in alloys, especially with those, as copper, which have a high temperature of fusion; but a little care and sometimes very simple special precautions will be found to readily evade such obstructions to its use.† The metal, weighing about two-thirds as much as aluminium and between one-fourth and one-fifth as much as iron or steel, has a more than proportional strength, and pieces of the metals having similar size will carry more nearly equal loads. The first at all complete studies of the constructive value of this metal and its alloys were made, on the initiative of the writer, as above, in the laboratories of Sibley College; to which laboratories he had turned over his collected material for that purpose, mainly, at the time, with a view to securing some definite knowledge of its value for the purposes of 'aëronautic engineering,' and with the intention, actually carried into effect, of reporting the outcome to the International Engineering Congress at Chicago in 1893. The result was to show that aluminium might be considerably strengthened by alloying with magnesium in small quantities as above; but that the alloying metal was itself stronger than the alloys, and that the presence of aluminium reduced the strength of magnesium.

The best comparison of these metals and their alloys is that by comparing the lengths of bars of the metal, suspended from one end, that can be carried without breaking. The extreme range of the tenacities of magnesium was between 20,000 and 30,000 pounds per square inch, corresponding to a

* Mr. Marks is now Assistant Professor of Mechanical Engineering at Harvard University and Mr. Barracough has charge of the Department of Electrical Engineering at the University of Sidney, N. S. W., of which institution he is an alumnus. Mr. Marks is a graduate of the University of London and of Mason College, Birmingham, England.

† The writer employed magnesium for illuminating and for signal purposes about the close of the civil war (1864–65), and, while stationed at the U. S. Naval Academy (1865–71) experimented with a variety of signal apparatus devised by himself for long-distance work, as above. The most successful forms of apparatus for this application of the metal were constructed for the use of magnesium in powder, in which a suitable proportion of sand was used to insure free flow as well as economy. The most successful form for other illumination, as photography, stationary signal lamps, theater tableau work, etc., was the ribbon lamp, of which latter a large number were in use when the electric light entered the field and threw them out. See 'A New Marine Signal Light,' describing this apparatus (patented in May, 1866), *Journal Franklin Institute*, 1867, R. H. Thurston, in which paper the writer gives the costs of signalling: sixty cents by the magnesium apparatus employed by him, and six dollars for the same message sent by the then usual Coston signals. The marine apparatus was taken by Admiral Luce on his cruise to the Mediterranean in the summer of 1866, and the army signal was employed by General Myer about Washington. The latter is now in the possession of the writer. It was built from the designs of the writer by the American Magnesium Co. of Boston.

suspension of 30,000 to 40,000 feet. This is the equivalent of steel of about 100,000 pounds tenacity. Could the cast portions of the steam-engine be made in this material for our torpedo-boats or aëronautic and automobile machinery their weights would be reduced about one-half. It remains to be seen whether, the costs permitting, this change would be to any extent practicable. Dynamos have been constructed, in the shops of Sibley College, of aluminium and a gain thus secured for portable and automobile work of some importance, and it is possible that magnesium, with its higher tenacity and greater lightness, may prove the coming material for some such work. Costs will undoubtedly fall rapidly with increasing area of market.

R. H. THURSTON.

SCIENTIFIC BOOKS.

La constitution du monde. By MADAME CLÉMENCE ROYER. Published by Schleicher Frères, 15 Rue des Saints-Pères, Paris. Containing 799 pages, 100 chapters, 92 figures, and 4 plates.

This pretentious volume is claimed by its author to contain a new and satisfactory philosophy of nature including everything from the geometrical structure of molecules to a theory of the evolution of worlds. In a somewhat remarkable preface the author expresses in forcible terms her contempt for those philosophers who maintain that certain things are unknowable, and asserts that their speculations were advanced to enslave the minds of men and support the dogmas of theologians. The following quotations of remarks concerning scientific subjects will indicate her attitude of mind: "The kinetic theory of gases is certainly a romance conceived by the imagination of a German mathematician." The non-euclidian geometries "founded on sophistic generalizations of analysis * * * have for their result and their end, the clouding of the intellect in undermining the foundations of rational certitude, to the profit of those who are attempting to reduce mankind * * * to the *credo quia absurdum* of blind and unquestioning faith."

The ideas advanced upon scientific questions are not worth the space that it would require to enumerate them, much less to make any critical comments. They indicate, as is in reality confessed in the preface, that the author has read, though widely, with a mind strongly biased by preconceived notions, and they show at every point a lamentable lack of scientific training and spirit. The contents of the 99th chapter are sufficient to illustrate the statement. The author in her 'evolution du monde' supposes that at some remote time a planet from exterior space struck Saturn a glancing blow greatly accelerating its rotation; that the Saturnian oceans and portions of the solid crust were hurled off and formed the rings, which are ice, or perhaps aluminium; that the striking planet was broken up forming the satellites of Saturn, Jupiter, Uranus, Neptune, Mars, and the Moon, the asteroids, the meteor streams; that Venus and Mercury have no satellites because they were on the opposite side of the sun when the collision occurred; that the Moon and the satellites of Mars move with less linear velocity than those of the larger planets because they are so far from Saturn that the velocities of the flying fragments had largely died out before they reached their respective primaries; and that the second satellite of Mars 'by a remarkable exception does not fulfill the laws of Kepler.' The figure inserted in the chapter makes the theory very clear.

It is to be regretted, for the sake of the author who devoted so much time to writing the book, and for the sake of Madame Valentine Barrier who bore the expense of its publication, that it is impossible to say that the work is worth reading. F. R. M.

The Chemistry of Soils and Fertilizers. By HARRY SNYDER, B.S., Professor of Agricultural Chemistry, University of Minnesota, and Chemist of the Minnesota Agricultural Experimental Station, Easton, Pa. The Chemical Publishing Company. 1899. 12mo. ix + 277 pp. Price, $1.50.

This book is the outgrowth of courses of instruction given at the University of Minnesota